

Returns to Irrigated Cultivar Development in Senegal



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The payoff to research and development of three high-yielding irrigated rice varieties by WARDA's Sahel Station is likely to exceed 100% per year over the period of 1995–2004 according to independent researchers Monica Fisher, William Masters and Mamadou Sidibé of Purdue University, USA. These new varieties, officially released in Senegal in 1994, are rapidly replacing earlier introductions and owe such strong performance to low development costs and, in the case of Sahel 108, to its shorter cycle which permits double cropping on the same parcel of land.

WARDA's Cultivar Improvement in Senegal

The varietal technology used in the Senegal River valley (SRV) has changed little since the mid-1970s. Prior to the release of Sahel 108, Sahel 201 and Sahel 202 in 1994, nearly 90% of all farmers used only one or two rice cultivars, medium-duration Jaya and short-duration I Kong Pao (IKP) introduced around 1970. While Jaya has a high yield potential, it is not tolerant to saline conditions present in the delta and its cycle length prohibits double-cropping. IKP, on the other hand, may be grown in any season, but has poor grain quality and lower yield potential than Jaya.

Of critical importance for increased rice productivity and farm incomes is the release of short-duration cultivars that increase the possibility for rice–rice double cropping. Whereas in the past scientists have focused on high yields for increased productivity, double-cropping is now recognized as being the key factor for intensification in the SRV.

In 1994, WARDA and the *Institut sénégalais de recherches agricoles* (ISRA) proposed three new cultivars for release. Sahel 108 was targeted for the dry season when short duration is impor-

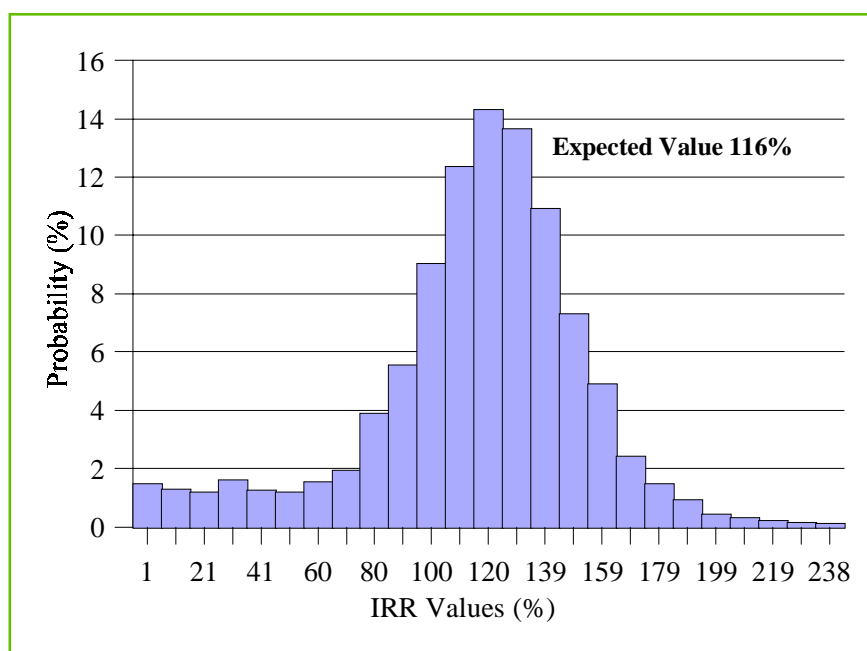
tant for enabling farmers to double-crop. Sahel 201 and Sahel 202 are medium duration and therefore targeted for use in the rainy season. Sahel 201 was introduced for high yield and moderate tolerance to salinity and Sahel 202 for high yield with good grain quality.

The Sahels yield approximately 10% more than the existing varieties in the wet season and Sahel 108 about 11% more in the dry season. However, Sahel 108 matures about 15 days earlier than Jaya during the wet season and opens up new possibilities for double-cropping on the same parcel of land, potentially doubling per-hectare annual output.

Rates of Return in an Uncertain Climate

To evaluate the impact of WARDA cultivar development, the authors adapted the standard Akino and Hayami economic surplus model to Senegalese conditions. The study determines the public gain to investment in rice research when this investment increases the supply of locally produced rice and displaces imports. The indicator used to calculate the social impact of the technology introduction is the internal rate of return (IRR) measure. The IRR is the interest rate at which research investment funds repay their debt to society. The IRR criterion is to accept all projects that have an IRR greater than or equal to the cost of capital, usually expressed as the locally observed interest rate.

Since this study is an *ex-ante* impact assessment calculation and based upon initial estimates of diffusion and adoption of the new varieties, the study calculates the range of all possible IRR values and the probability that each outcome will appear. One key element of the rate of return calculation is the rate of diffusion and adoption of Senegalese farmers. The study authors relied upon expert opinion from WARDA and ISRA on the



rate of adoption and then *discounted* these estimates by 25% and 50% to arrive at very conservative rates of adoption. Finally, the authors varied the adoption rate derived from expert opinion to estimate the probability of each outcome.

The Pay-off to Cultivar Development

The authors determined that investment into WARDA research on the Sahel varieties from 1990 to 1995 is almost certain to have a very high payoff over the 1995–2004 period. The expected value of the IRR is 116% with a standard deviation of 39%. The expected value provides strong evidence that research on the Sahels has been well spent.

As indicated in the figure above, most estimates of the IRR fall into high values. However, the probability of the IRR falling into extremely high values is very low and over 95% of the sampled values are less than or equal to 175%.

There are also positive probabilities of attaining very low values of IRR. The lowest sampled value of the IRR is 1.26%. However, there exists only a 2.5% chance that the IRR will fall below the interest rate of 18%. Thus, the results

indicate that using the IRR criterion there exists a 97.5% probability that the investment in the development of the Sahels has been worthwhile.

High payoffs to WARDA's Senegal Rice program highlights the importance of applied research addressing location-specific needs. A well-targeted program, borrowing from the global pool of germplasm and expertise to select key traits in a relatively brief period of time, can yield enormous benefits. Even under uncertainty, the gains from such research are very likely to outweigh the costs.

For more information

Fisher, M., W.A. Masters and M. Sidibé, 1998. Technical Change in Senegal's Irrigated Rice Sector: Impact Assessment under Uncertainty. *WARDA Ex-Ante Impact Assessment of Rice Research Bulletin* No. 98-1, Bouaké, Côte d'Ivoire: WARDA.
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